Remarks:

These remarks are responsive to the Office action dated November 4, 2010. Prior to entry of this response, claims 1-5 and 7-11 were pending in the application. By way of this response, claims 1, 5, and 7 are amended. Applicants respectfully request reconsideration of the application and allowance of the pending claims.

Rejections under 35 U.S.C. § 103

Claims 1-5 and 7-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,545,443 (Yamada et al., hereinafter Yamada) in combination with "Growth of Epitaxial ZnO thin films by organometallic chemical Vapor Deposition" (Lau et al., hereinafter Lau) further in combination with U.S. Patent No. 5,002,796 (Nishida).

Applicants respectfully traverse the rejections. Nevertheless, claim 1 is amended herein to recite:

> A method for making a tandem thin-film photoelectric converter comprising a transparent electrode layer, at least one amorphous silicon photoelectric conversion unit, at least one crystalline silicon photoelectric conversion unit, and a back electrode layer stacked in that order on a transparent insulating substrate, the method comprising a step of forming the back electrode layer by the method for making a transparent conductive film comprising introducing an organozinc compound and a mixed gas in which an oxidizing agent is diluted with a hydrogen gas, into a deposition chamber to form a transparent conductive film containing zinc oxide as a main component on a substrate disposed in the deposition chamber, the transparent insulating substrate being used as the substrate, wherein a temperature of the substrate is from 50°C to 300°C and a pressure in the deposition chamber is from 0.01 to 3 Torr.

Support for this amendment can be found in paragraphs [0033] and [0040] of the subject application. This configuration allows the organozinc compound to be oxidized and deposited on the substrate by using hydrogen gas as a dilution gas while keeping the temperature of the substrate relatively low. Maintaining a low substrate temperature may allow the recited method to be used with durable, transparent substrates, such as glass, that are abundant and inexpensive and thus desirable for manufacturing solar cells, as such substrates will not often withstand high heat. Furthermore, as recited in claim 1, the zinc oxide is deposited onto a crystalline silicon photoelectric conversion unit. Such conversion unit layers may be sensitive to heat. Therefore, the method of amended claim 1 helps to prevent exposing such substrates and structures to damaging temperatures. In

addition, hydrogen gas has the advantage of being inexpensive while maintaining a high thermal conductivity. Thus, the resistivity of the photoelectric converter is decreased compared to converters of similar structure where argon is used as the dilution gas.

The cited combination of references does not teach or suggest all of the elements of amended claim 1. First, the cited combination of the references does not teach or suggest at least a method of depositing zinc oxide onto a crystalline silicon photoelectric conversion unit using a chemical vapor deposition method with hydrogen as the carrier gas. Instead, both Yamada and Nishida describe methods for depositing a layer of zinc oxide onto a substrate using argon as a carrier gas, and are silent as to the use of hydrogen gas.

Lau discloses mixing an oxidizing agent (water) with hydrogen gas in an expitaxial deposition of zinc oxide on sapphire. Applicants submit that the teachings of Lau would not lead one of ordinary skill in the art to have a reasonable expectation of achieving similar success and improved uniformity via the cited combination of references. Indeed, Lau actually teaches that using H_2O/H_2 is likely **not** to achieve similar success. First, Lau teaches the growth of epitaxial films on sapphire, which is a different process that utilizes different conditions compared to amended claim 1. For example, Lau teaches (in Table 1) that the substrate temperature during deposition is 400 degrees Celsius, and (at page 1844, 7^{th} line from bottom of left column) that the pressure during deposition is 400 Torr. These are conditions that may be unsuitable for glass substrates. Further, Lau teaches that the use of the hydrogen gas and water in a CVD deposition resulted in a film that was "pale white translucent with a rough surface." Lau, pages 1845-46. This film, being pale white translucent, would be unsuitable for the use intended in the subject application, which requires a transparent thin film in order to be used in a solar cell. Lau actually teaches that better results are achieved with a N_2O/N_2 process, at pages 1845-46. Furthermore, the "improved uniformity and surface finish" referred to in the Office action is a statement made in the background section of Lau, referring to a technique used to deposit zinc oxide by RF sputtering, not chemical vapor deposition. Thus, Lau actually teaches away from using a H_2O/H_2 CVD process for forming ZnO films. In light of this fact, as well as the differences between the processes, substrates, and conditions of amended claim 1 compared to Lau, one of ordinary skill in

the art would not have a reasonable expectation of success in combining the teachings of Lau with the other cited references.

Further, as mentioned above, Lau discloses an epitaxial process, where the substrate acts as a seed crystal, and thus the deposited film lattice structure and organization are the same as that of the substrate. This is in contrast to the CVD process of claim 1, which does not form a film with such a relationship to the substrate lattice. It is noted that epitaxial growth requires the substrate to be at a high temperature during the deposition process. For example, Lau as mentioned above, describes using a temperature of 400°C and a pressure of 400 Torr for epitaxial ZnO growth using H_2O/H_2, and such conditions did not result in the growth of a desirable film.

In view of the above, Applicants submit that it would not be obvious to combine the deposition methods of Yamada and Nishida with the epitaxial method of Lau. Therefore, Applicants respectfully request the rejection of claim 1 be withdrawn. Furthermore, dependent claims 2-5 are allowable for at least these reasons.

Next, claim 7 has been amended to recite:

> A method for making a tandem thin-film photoelectric converter comprising a transparent electrode layer, at least one amorphous silicon photoelectric conversion unit, at least one crystalline silicon photoelectric conversion unit, and a back electrode layer stacked in that order on a transparent insulating substrate, the method comprising a step of forming the transparent electrode layer by the method for making a transparent conductive film comprising introducing an organozinc compound and a mixed gas in which an oxidizing agent is diluted with a hydrogen gas, into a deposition chamber to form a transparent conductive film containing zinc oxide as a main component on a substrate disposed in the deposition chamber, the transparent insulating substrate being used as the substrate, wherein a temperature of the substrate is from 50°C to 300°C and a pressure in the deposition chamber is from 0.01 to 3 Torr.

Claim 7 recites a method for making a transparent electrode layer similar to the method recited in claim 1. Thus, claim 7 is allowable for at least the reasons discussed above in regards to claim 1. Applicants respectfully request the rejection of claim 7 and dependent claims 8-11 be withdrawn.

Next, claims 1-5 and 7-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over International Reference No. 03021690 - translation provided by U.S.

Patent No. 7,390,731 (Kroll et al., hereinafter Kroll) - in combination with U.S. Patent No. 4,751,149 (Vijayakumar et al., hereinafter Vijayakumar) in combination with Lau.

Applicants respectfully traverse this rejection. Kroll discloses a method for depositing zinc oxide on a substrate such as glass for use in a solar cell, wherein the zinc oxide and oxidizing substance (water) are introduced in the deposition chamber in liquid form. However, hydrogen gas is not used as a carrier gas. Vijayakumar discloses a method for depositing zinc oxide on a substrate using an inert gas such as argon or helium. The processes described in Kroll and Vijayakumar are substantially similar to the processes described in Yamada and Nishida. Therefore, a person of ordinary skill in the art would not be motivated to combine Kroll and Vijayakumar with Lau for the same reasons discussed above. Therefore, Applicants respectfully request this rejection of claims 1-5 and 7-11 be withdrawn.

Conclusion

Applicants believe that this application is now in condition for allowance, in view of the above amendments and remarks. Accordingly, Applicants respectfully request that the Examiner issue a Notice of Allowability covering the pending claims. If the Examiner has any questions, or if a telephone interview would in any way advance prosecution of the application, please contact the undersigned attorney of record.

Please charge any cost incurred in the filing of this response, along with any other costs, to Deposit Account No. 503397.

Respectfully submitted,

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